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Evidence suggests that female military populations are at greater risk than their male counterparts for certain training and combat-related illnesses and injuries. Precise etiologies, risk factors, and impact of disease and injury in military women are not available. The objective of this prospective, multisite, epidemiological study was to define the patterns of illness and injury in military women during training. Musculoskeletal injuries were emphasized due to their high cost in terms of morbidity, lost training time, and attrition. A computer-based outpatient tracking system for prospective data collection was developed for use at (1) OCS, Quantico (USMC female officers); (2) MCRD, Parris Island (USMC enlisted women); and (3) RTC, Great Lakes (USN enlisted women). The most common reason for a medical encounter at all three sites was musculoskeletal injury. The percentage of women with at least one medical encounter at OCS (n=303), MCRD (n=2,766), and RTC (n=8,865) was 87.1%, 69.4%, and 95.3%, respectively. The selected general and specific diagnoses were determined with incidence rates for each training site. The databases will be used to address morbidity and attrition issues and target areas for future preventive intervention.

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Introduction

Studies to date describing the patterns of disease and injury in active-duty military populations have dealt almost exclusively with men. However, evidence suggests that women use medical facilities more frequently[1] and are at greater risk, relative to men, for certain types of training[1,2] (Kimsey CD. Unpublished doctoral dissertation. 1993) and combat-related[3-6] illnesses and injuries. Precise information to characterize the rates of specific diagnoses and injuries in military female populations is necessary to determine the impact of illness on training, attrition, operational readiness, and the overall health and well-being of military women.

Several studies have indicated that the injuries and illnesses in military women in both operational and training communities may be amenable to preventive interventions. Markenson and colleagues reported that a large proportion of the gynecological resources at Operation Desert Storm's Eighth Evacuation Hospital was used to treat preventable conditions.[7] Another Desert Storm study showed that female veterans with predeployment histories of sexual or physical abuse were more likely to suffer combat-related posttraumatic stress disorder.[3] Finally, several studies involving female military trainees have demonstrated a strong association between risk of musculoskeletal injury during basic training and baseline levels of physical fitness (Kimsey CD. Unpublished doctoral dissertation. 1993).[1,2,7-10]

Applying solid epidemiological methodology to determine the etiology and impact of morbidity on training programs is crucial. At the Naval Health Research Center (NHRC) we developed a field-tested, computer-based outpatient tracking system to obtain the detailed epidemiological information required for analytic studies. This paper describes the epidemiology of outpatient encounters for women during U.S. Navy (USN) and U.S. Marine Corps (USMC) recruit training as well as Marine Corps officer candidate training.

Methods

Study Population

This project was a multi-site, prospective, epidemiological study of all female trainees at three sites, including the Marine Corps Recruit Depot (MCRD), Parris Island, SC; the Navy Recruit Training Command (RTC), Great Lakes, IL; and the Marine Corps Officer Candidate School (OCS), Quantico, VA. Beginning in April 1995, all

outpatient encounters (injury and general illness) were captured using an outpatient clinic surveillance system at each site.

Surveillance Period

The study subjects for this report were determined by the time frame of the operation of the outpatient tracking system at each of the two Marine Corps sites and the one Navy site. The MCRD, Parris Island, data were collected between April 1995 and June 1996 for the 2,766 women arriving in basic training during that time. The system at OCS, Quantico, was installed in January 1995; however, the morbidity data for this report came from the 303 women trained during the summers of 1995 and 1996. Finally, data collection for RTC, Great Lakes, commenced in April 1995, and the data for this site came from the 8,865 women who arrived for basic training from April 1, 1995, to September 30, 1996. However, from March 1, 1996, to May 31, 1996, failures in the data entry system at RTC, Great Lakes, did not allow the capture of all encounter data so those 3 months were excluded. Also, for a 3-month surveillance period, June 1, 1996, to September 30, 1996, for the 2,105 women in training during that interval, more specific ICD-9[11] codes for genitourinary conditions were added to the RTC, Great Lakes, system. This was done primarily to capture the follow-up visits for pelvic exams performed during recruit processing.

Military Training

The duration and type of military training at each site differs with the needs of the services. Training at MCRD, Parris Island, is a 13-week physically arduous program with a very regimented schedule of activities. Many activities are performed in the military "field" setting, emphasizing weapons and combat training and Corps values. Women are trained in platoons of 60 to 80 recruits. Navy basic training at RTC, Great Lakes, is a 9-week program that emphasizes academics, naval education, and Navy values. The program includes a very active schedule but emphasis is not placed on strenuous physical activity. Women are trained in divisions of 60 to 84 recruits. Recruits at both sites live and train together in these tightly knit training units. OCS varies in duration depending on the background of the trainee. Some candidates attend a 10-week course, and others attend a 6-week course. This training is very physically demanding, and trainees are encouraged to perform much of this physical training at an individual pace. Women are trained only during the summer months at OCS.

Automated Surveillance System

The system is a value-added package, which requires a minimum of a 386 microprocessor and uses the database software Microsoft FoxPro, Version 2.5, as its platform. The Sport Medicine and Research Team System (SMARTS) system records collected variables. The variables cover a wide range of demographic data, training cycle data, encounter data, clinically suspected risk factors, confounding variables, and the diagnosis of each patient presenting to the clinic. The majority of variables were identical at all three sites. The system core variables are noted in Table 1.

Morbidity Classification

Every encounter the tracking system captures is coded by the specific ICD-9 diagnosis. An expanded set of ICD-9 codes were devised for musculoskeletal/orthopedic diagnoses. For the purposes of this report, we grouped the wide variety of diagnoses in the disease categories according to the general ICD-9 groupings. We subcategorized some of the general disease groups to break out specific disease diagnoses or conditions of interest to training populations.

Analysis

Epidemiological data presented for this report were based on encounters at the medical treatment facility for new injuries and illnesses developed during training. We calculated incidence ratios as the number of women with at least one occurrence for a general diagnostic category or specific diagnosis, divided by the total number of women for that site, and presented per 100 women. At each study site we calculated the frequency distribution of each general diagnostic category as the number of new encounters for a given category divided by the total number of new encounters for that site.

Results

Outpatient Visits

At RTC, Great Lakes, 7,395 (83%) of the 8,865 female Navy recruits had 19,883 medical encounters, with 14,238 new diagnoses during the 9 weeks of basic training. Two hundred and sixty (86%) of the 303 female Marine Corps officer candidates had 1,234 medical visits and incurred 589 new diagnoses during OCS. Of the 2,766 female Marine Corps recruits at MCRD, Parris Island, there were 6,068 medical encounters among 2,002 (72.4%) of the recruits, with 4,995 new diagnoses during the 13 weeks of basic training. During the 3-month period of detailed coding for specific gynecologic diagnoses at RTC, Great Lakes, approximately 47% of the 2,105 women had a visit for a gynecologic exam. These were primarily for follow-up of the processing pelvic exam; 34.5% of all women processed during this period had an "abnormal" Pap smear, with 14.2% of them specified as cervical intra-epithelial neoplasm (CIN) I or CIN II.

Figures 1, 2, and 3 show the distribution of morbidity for all new medical encounters at the three surveillance sites. Of note, the majority of medical encounters for a new diagnosis in all three training populations was for musculoskeletal injuries, with the greatest proportion in Marine Corps officer candidates (45.2%), followed by Marine Corps recruits (32.5%), and Navy recruits (32.3%). Respiratory/ear, nose, throat (ENT) and dermatological conditions were the other two most common categories of illness for initial visits in all of the training populations.

Illness and Injury Incidence

Table II presents illness and injury incidence at all three sites. During boot camp at RTC, Great Lakes, 37.2% of all female recruits reported to the medical clinic with a musculoskeletal injury, 24.4% had a respiratory/ENT disorder, 19.2% had a dermatological process, and 11.6% presented with gynecological disorders. Musculoskeletal injuries occurred in 61.7% of female officer candidates at Marine Corps OCS. Dermatological disorders were seen at the clinic in 23.0% of Marine officer candidates, and 26.1% of candidates reported with respiratory/ENT disorders. Among female Marine Corps recruits at MCRD, Parris Island, musculoskeletal injuries

were seen at the medical clinic in 44.4% of all recruits, and 22.2% were seen at least once for respiratory/ENT disorders. The most common single condition among all three populations was upper respiratory infection (URI).

Musculoskeletal Injuries

The incidence of the most common specific musculoskeletal injuries at RTC, Great Lakes; OCS, Quantico; and MCRD, Parris Island, are presented in Table III. The types of injuries most commonly reported by all three sites fall into the classification of overuse problems. Stress fractures, an overuse injury with a high impact on training programs, occurred in 3.9% of female Navy recruits, 9.6% of female Marine Corps officer candidates, and 5.7% female Marine Corps recruits. Of note, acute injuries occurred more often in the Marine Corps officer candidates than in the recruit populations; 14.5% of the candidates presented with an ankle sprain; and 2.6% incurred a closed fracture.

Conclusions

This prospective, multi-site, epidemiological study establishes a high rate of overall morbidity and heavy utilization of medical services in three Navy and Marine Corps female trainee populations. The majority of women, including 83.4% of RTC recruits, 60.4% of MCRD recruits, and 85.8% of OCS candidates, had at least one medical encounter during training. Musculoskeletal injury, with an incidence rate ranging from 37.2% to 61.7%, was the most common diagnostic category in all three populations. This was followed by respiratory illnesses (incidence ratio [IR]: 22.2-26.1%), and dermatological disorders (IR: 10.7-23.0%). This high rate of illness and injury suggests that medical morbidity has a high impact on the effectiveness of these programs.

Only a few studies of ambulatory morbidity rates in military populations permit data comparison. Misner documented outpatient clinic visits over a 12-month surveillance period in both male and female Army recruits and soldiers in garrison.[12] Although incidence rates were not available, the average number of visits per female trainee per month during boot camp was 0.35 (839 encounters among 2,342 trainee months). The primary diagnoses for more than 70% of the visits were musculoskeletal in origin. This contrasts with the current study in which the comparable rate is 1.08 (28,933 visits among 26,785 trainee months) and there is a higher representation of respiratory infections and dermatological diseases. Misner also described an average of 3.47 encounters per female

soldier in garrison over 12 months. The primary diagnoses, as in the current study, were musculoskeletal, respiratory, or dermatological in nature. Another study, examining health care utilization aboard navy ships, found 0.695 visits per female crew member per month with the major diagnostic categories being infectious, gynecologic, and respiratory.[13]

Women consistently have been shown to have higher morbidity rates and to use health care services more than men.[14] In our analyses, the study populations were limited to female trainees, and thus, comparative data for male trainees were not available. However, in a 1993 study of musculoskeletal injury in male MCRD recruits that utilized the same outpatient tracking software system and procedures, 61% of male recruits (805 of 1,318) presented to the medical clinic with a new injury or illness diagnosis.[10] As with the female trainees, the primary diagnostic category was musculoskeletal injury. The total number of encounters for this population was 2,235, for a ratio of 0.57 encounters per male trainee months (2,235 visits in 3,954 trainee months). These data suggest that the morbidity rate of injury and illness is also high for male Marine Corps recruits.

Musculoskeletal injuries were the most common cause of morbidity in all three training populations with incidence rates consistent with previously published studies.[15,16] The epidemiology of musculoskeletal injuries varies, depending on the type and intensity of the individual training program. Significantly, the frequency of musculoskeletal injury in the three populations can be directly correlated to the intensity of the training. In the most physically demanding training program, OCS, 61.7% of all women presented with a musculoskeletal injury. The injury rate at MCRD was slightly less, with 44.3%. The lowest injury rate of 37.2% was seen at RTC, Great Lakes, the study site with the least emphasis on physical training and conditioning. Stress fractures, which primarily occur in the setting of a rapid increase in weight-bearing physical activity, can be more accurate outcome measures of program intensity. A comparison of the stress fracture incidence rates of the three training populations resulted in similar findings, with the highest rate of 9.5% found in the Marine Corps officer candidates, followed by 5.7% in Marine Corps recruits and 3.9% in Navy recruits. Stress fractures were also an important outcome to track for clinical and research purposes because they are representative of a significant injury with a high fiscal and operational impact. Also noteworthy was the high rate of acute injuries among Marine Corps officer candidates, including ankle sprains (14.5%) and closed fractures (2.6%).

URI was the single most common diagnosis among all three populations. This is consistent with the

reported incidence of 2-3 URIs in adults per year in the United States.[17] There appears to be a higher rate of the more complicated respiratory infections, such as sinusitis, pneumonia, and otitis, than seen in the general population. For instance, the estimated rate of acute sinusitis is 0.5-2% of all URIs.[17] In these study populations, 2.2-7.9% of all trainees were diagnosed with acute sinusitis during recruit training, with a frequency of 15-44% of the URIs. Recruit populations, with crowded conditions and a high stress and activity level, have been shown to be at high risk for respiratory illnesses, caused by bacterial and viral pathogens.[18-20] These populations are also ideal for implementation of intervention strategies, such as chemoprophylaxis or vaccination.[21]

Most of the general and specific diagnostic categories had similar rates among the two recruit populations. However, two noteworthy differences exist: dermatological and neuropsychiatric. The higher dermatological rate among Navy recruits was primarily due to a difference in the treatment of blisters at the two sites. Navy recruits with blisters were seen at the clinic during this time period, whereas blisters among Marine Corps recruits were seen by specially trained recruits within the platoons, and only the serious cases were sent to the clinic. The lower neuropsychiatric rate of illness among Navy recruits was primarily due to incomplete surveillance. The mental health visits among Navy recruits were not captured since the data entry process was incompatible with the procedures at the Recruit Evaluation Unit at RTC, Great Lakes.

During the 3-month period of surveillance, nearly one third of 2,105 female Navy recruits required follow-up for an abnormal entry Pap smear. Dysplasia was documented in 14% of all recruits. An "abnormal" Pap smear, which may include an inadequate sample, inflammation, or the presence of atypical cells, was found in approximately 20% of the recruits. This rate of dysplasia and abnormal Pap smears has been reported previously in the literature[22] and may be an indicator of early sexual debut in female adolescents with attendant occult STDs, such as chlamydia and human papilloma virus.[23,24] Because these follow-up visits were not captured at the other two sites, comparable data in the Marine Corps recruits and officer candidates were not available.

Currently, no comprehensive system is available to classify illness and injury adequately for epidemiological purposes within the U.S. Navy and Marine Corps outpatient treatment facilities. Existing data sources, such as morbidity and mortality weekly reports, have a number of limitations. They do not include specific diagnostic information and cannot be validated. Confounding and suspected etiological variables are not measured, making these sources inadequate for precise, analytical epidemiological research. Also, the after-the-fact manner in

which these data are collected makes them unsuitable for research purposes. This study, which included comprehensive and accurate outpatient morbidity data collection in large numbers of military women, required the development of an outpatient tracking software application.

The software product developed and implemented at the three sites functioned as a research, a clinical, and an administrative database. As a research database the system provides a highly accurate and flexible "platform" for research studies, utilizing outpatient morbidity as hard outcomes. As a clinical database, the system collects specific diagnostic information for initial as well as follow-up encounters. These data are entered in close proximity to the actual encounter, which is another requirement of a clinical database. Finally, the administrative functions of this system permit the automated preparation of routine reports required by the specific outpatient clinic. Since most of these reports are composed of tallies of encounters in predetermined formats organized by various criteria, encounter information in an automated database is ideally suited for efficient production of these administrative reports.

Even with the adequate classification and collection of outpatient morbidity, determination of the population at risk is crucial to establishing incidence. Most military training populations are dynamic, with new individuals constantly being introduced into the population while other individuals are rotating or attriting out. The population at risk for training programs is typically presented as a function of trainee-time, such as a recruit-month, which is equal to one recruit in training for 30 days. Incidence densities, such as the number of encounters per recruit-month, do allow for the comparison of programs of different lengths, and they are very often the only method available to express the incidence of outpatient morbidity in military training.

However, incidence densities are very difficult to compare outside of training populations. The simple proportion of trainees who require a medical encounter for a specific diagnosis, or group of diagnoses, is more simply used and understood by the military training cadre. These incidence ratios, although simple to understand, are difficult to determine, due to the dynamic population at risk. Incidence calculation requires a cohort that can be followed throughout a participant's training period. This is a very labor-intensive effort, and it has a lengthy follow-up period.

The population chosen for these analyses was the total number of recruits who entered training during the study period. This denominator was simple to ascertain and, more importantly, resulted in incidence rates consistent with those derived from parallel cohort studies within the same populations. Using the number of individuals

entering training during the data collection window raises theoretical concerns. Encounters from the beginning of the time window are likely to be among individuals arriving at training prior to that time, and trainees arriving near the end of the time window have less time at risk. Another concern is that individuals separating from training early also have less time at risk. In our estimation, these concerns do not appear to be a practical problem when the time window for collecting encounters is sufficiently long and the individuals are arriving and departing at a steady rate. The rates of musculoskeletal injuries in general and stress fractures in particular among women at MCRD (44.3%, 5.7%) and RTC (37.2%, 3.9%) in this study are consistent with rates calculated by prospective cohort studies conducted in previous studies at NHRC in these same training sites (51.3%, 5.1%; and 37.5%, 3.0%, respectively).

In summary, this study developed and successfully implemented an outpatient automated tracking system in Navy and Marine Corps female trainees and established a comprehensive database of outpatient morbidity. The results demonstrate high rates of morbidity and health care utilization for these populations. In addition, the findings specifically identify musculoskeletal injuries, respiratory infections, and dermatological disorders as potential targets for preventive efforts.

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TABLE I

THE CORE VARIABLES USED IN THE AUTOMATED OUTPATIENT TRACKING SYSTEM

Demographic

Social security number

First and last name, middle initial

Date of birth

Sex

Race

Branch of military service

Paygrade

Current station

Date reported for duty

Encounter Information

Encounter date

Date data entered

Time checked in and out

Location of treatment facility

Position at facility

Military company/division of patient

Class

Phase of training

Week/day of training

Clinical Variables

ICD-9 code

Morbidity and Mortality Weekly Report (MMWR)

Visit number

Injury activity

Patient's complaint

Provider name

Provider comments

TABLE I cont

Disposition

Duty status

Number of disposition days

Preliminary or final diagnosis

Bilateral designation

Multiple diagnoses

TABLE II

INCIDENCE CATEGORIES/CONDITIONS AMONG FEMALE STUDY POPULATIONS

	RTC Great Lakes (N=8,865) 4/4/95 to 9/30/96		OCS Quantico (N=303) 6/1/95 to 9/30/96		MCRD Parris Island (N=2,766) 4/1/95 to 6/30/96	
Major Category/Specific Condition	Number	Incidence per 100	Number	Incidence per 100	Number	Incidence per 100
Allergy/Hematology	**154**	**1.7**	**2**	**0.6**	**48**	**1.7**
Anemia, iron deficiency	103	1.2	1	0.3	23	0.8
Cardiovascular	**300**	**3.4**	**25**	**8.3**	**106**	**3.8**
Dehydration	108	1.2	16	5.3	40	1.4
Dermatological	**1,743**	**19.6**	**70**	**23.0**	**297**	**10.7**
Blisters, ankle/foot/toes	685	7.7	47	15.5	11	0.4
Cellulitis	270	3.0	22	7.3	33	1.2
Contact Dermatitis	146	1.6	6	1.9	49	1.8
Tinea infections	409	4.6	—	—	66	2.4
Gastrointestinal Disorders	**794**	**8.9**	**40**	**13.2**	**264**	**9.5**
Constipation	116	1.3	1	0.3	68	2.5
Gastritis/Gastroenteritis	646	7.3	31	4.3	172	6.2
Genitourinary	**1,025**	**11.6**	**6**	**1.9**	**239**	**8.6**
Menstrual disorders	122	1.4	—	—	38	1.4
STDs	456	5.1	—	—	26	0.9
Urinary system disorders	178	2.0	6	1.9	89	3.2
Vaginitis	328	3.7	—	—	104	3.8
Musculoskeletal	**3,296**	**37.2**	**187**	**61.7**	**1,227**	**44.4**
Stress fractures	351	3.9	29	9.5	159	5.7
Neuropsychiatric	**267**	**3.0**	**13**	**4.3**	**259**	**9.4**
Headaches	126	1.4	5	1.7	45	1.6
Other	**950**	**10.7**	**29**	**9.6**	**443**	**16.0**
Opthalmological	**144**	**1.6**	**8**	**2.6**	**39**	**1.4**
Respiratory/ENT	**2,170**	**24.4**	**79**	**26.1**	**615**	**22.2**
Otitis	251	2.8	1	0.3	107	3.9
Pharyngitis/tonsillitis	325	3.6	12	3.9	85	3.1
Upper respiratory infection	1,476	16.6	55	18.1	395	14.3
Sinusitis	348	3.9	24	7.9	60	2.2
Lower respiratory infection	276	3.1	8	2.6	60	2.2

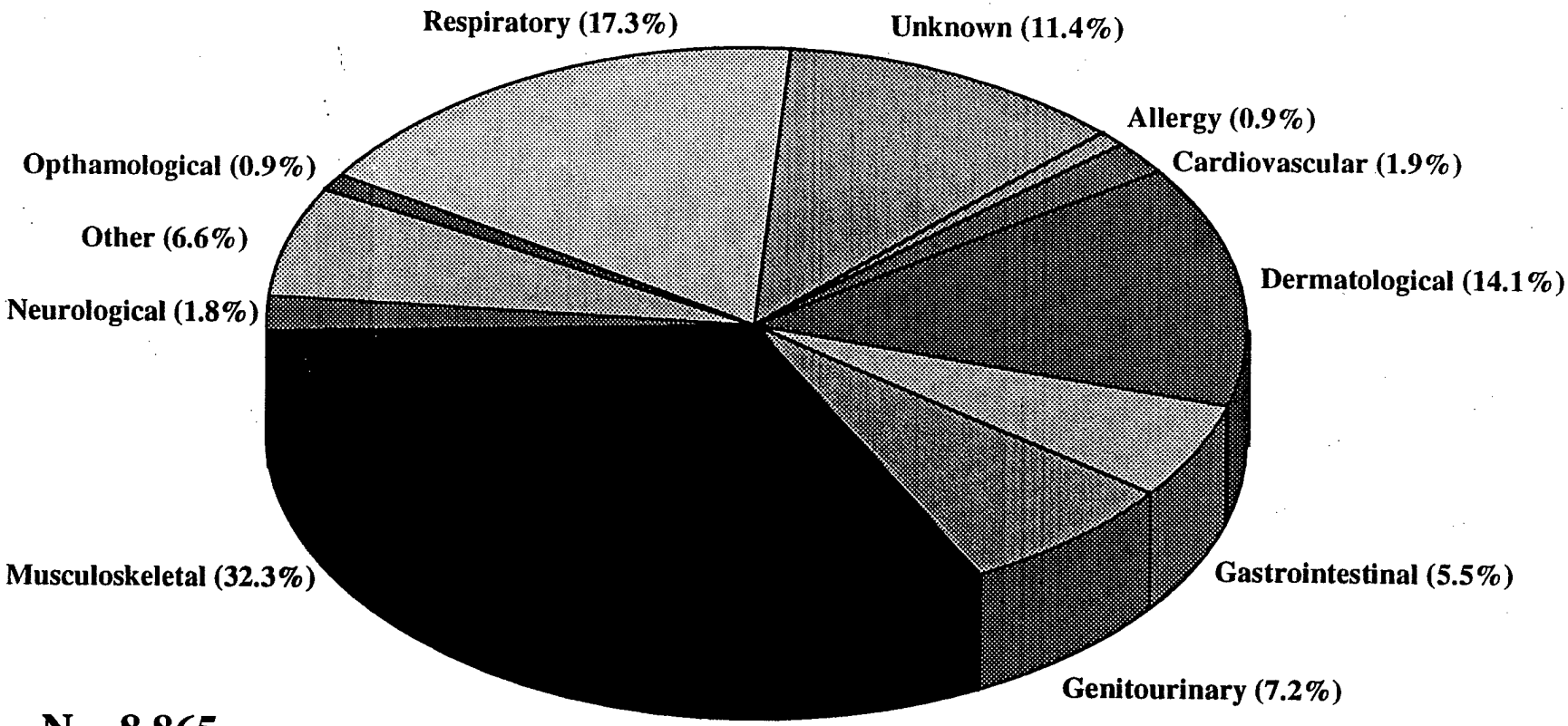
TABLE III

INCIDENCE OF THE MOST COMMON SPECIFIC MUSCULOSKELETAL INJURY DIAGNOSES

AMONG FEMALE STUDY POPULATIONS

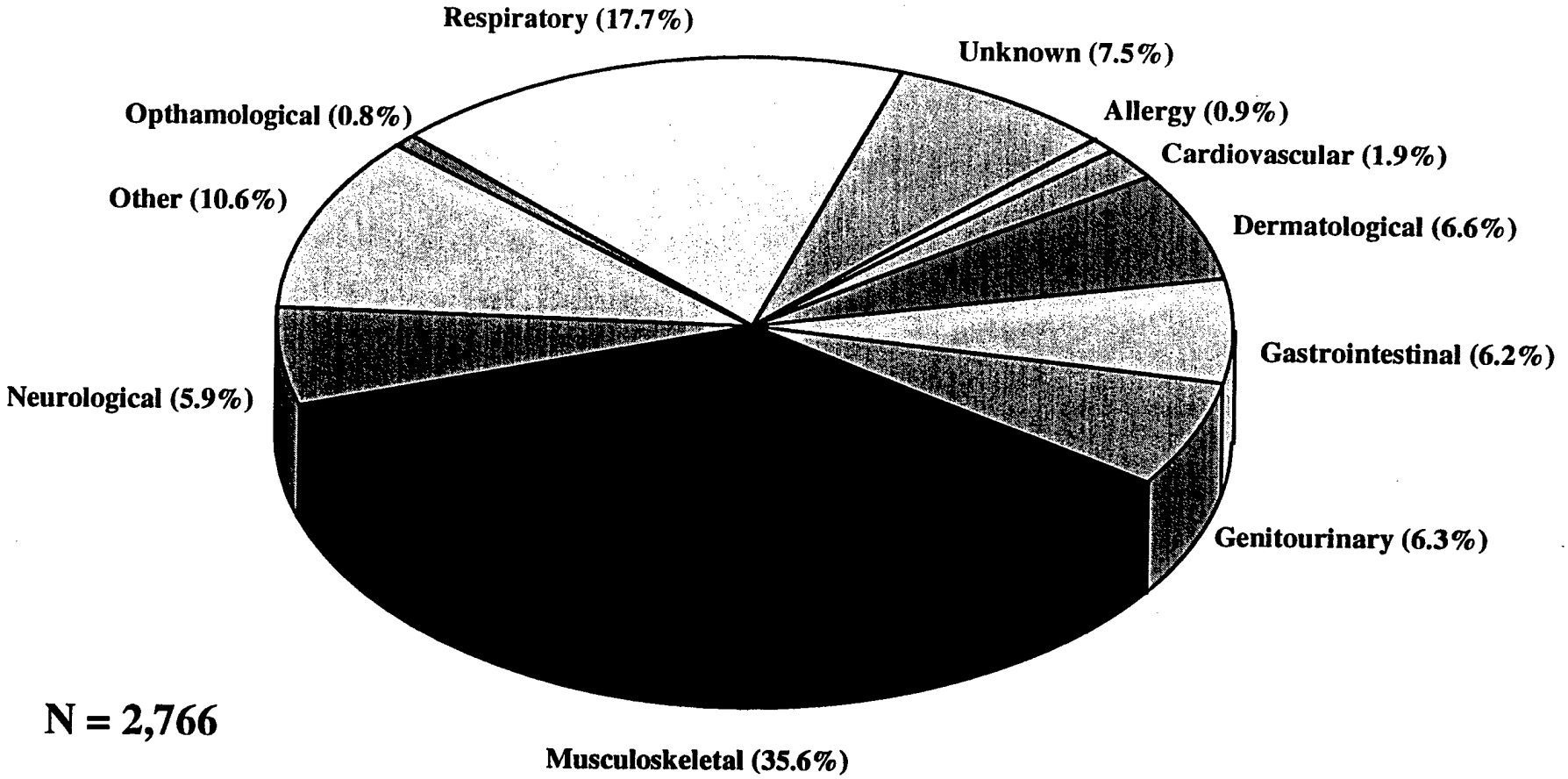
	RTC Great Lakes (N=8,865) 4/4/95 to 9/30/96		OCS Quantico (N=303) 6/1/95 to 9/30/96		MCRD Parris Island (N=2,766) 4/1/95 to 6/30/96	
Disorder	Number	Incidence per 100	Number	Incidenceper 100	Number	Incidence per 100
Achilles tendinitis/bursitis	31	0.3	15	4.9	24	0.9
Ankle sprain	341	3.9	44	14.5	162	5.9
Back pain, all sites	368	4.2	14	4.6	48	1.7
Capsulitis, ankle	307	3.5	—	—	—	—
Contusions, ankle/foot/toes	79	0.9	6	2.0	53	1.9
Contusions, knee	27	0.3	3	1.0	48	1.7
Fracture, closed	20	0.2	8	2.6	11	0.4
Iliotibial band syndrome	80	0.9	20	6.6	95	3.4
Metatarsalgia	384	4.3	—	—	4	0.1
Pain, ankle	18	0.2	10	3.3	5	0.2
Pain, foot	36	0.4	19	6.3	3	0.1
Pain, knee	32	0.4	22	7.3	40	1.4
Pain, wrist	76	0.9	2	0.7	5	0.2
Patellofemoral syndrome	386	4.4	12	4.0	168	6.1
Plantar fasciitis	431	4.9	17	5.6	27	1.0
Shin splints	341	3.9	18	5.9	163	5.9
Sprain/strain, back	16	0.2	9	3.0	91	3.3
Sprain/strain, knee/lower leg	16	0.2	11	3.6	42	1.5
Strain, hamstring/biceps femoris	14	0.2	4	1.3	46	1.7
Strain, hip (Adductors)	13	0.2	7	2.3	95	3.4
(Flexors)	1	<0.1	2	0.7	17	0.6
(Unspecified)	4	<0.1	6	2.0	49	1.8
Strain, trapezius	19	0.2	2	0.7	44	1.6
Stress fractures	351	4.0	29	9.6	159	5.7
Tendinitis, ankle/foot	185	2.1	18	5.9	65	2.3
Tendinitis/bursitis, knee	170	1.9	—	—	59	2.1
Tendinitis, patellar	130	1.5	8	2.6	96	3.5

Fig. 1
Distribution of morbidity among
RTC, Great Lakes, female recruits (14,238 new encounters)
1 APR 95-30 SEP 96



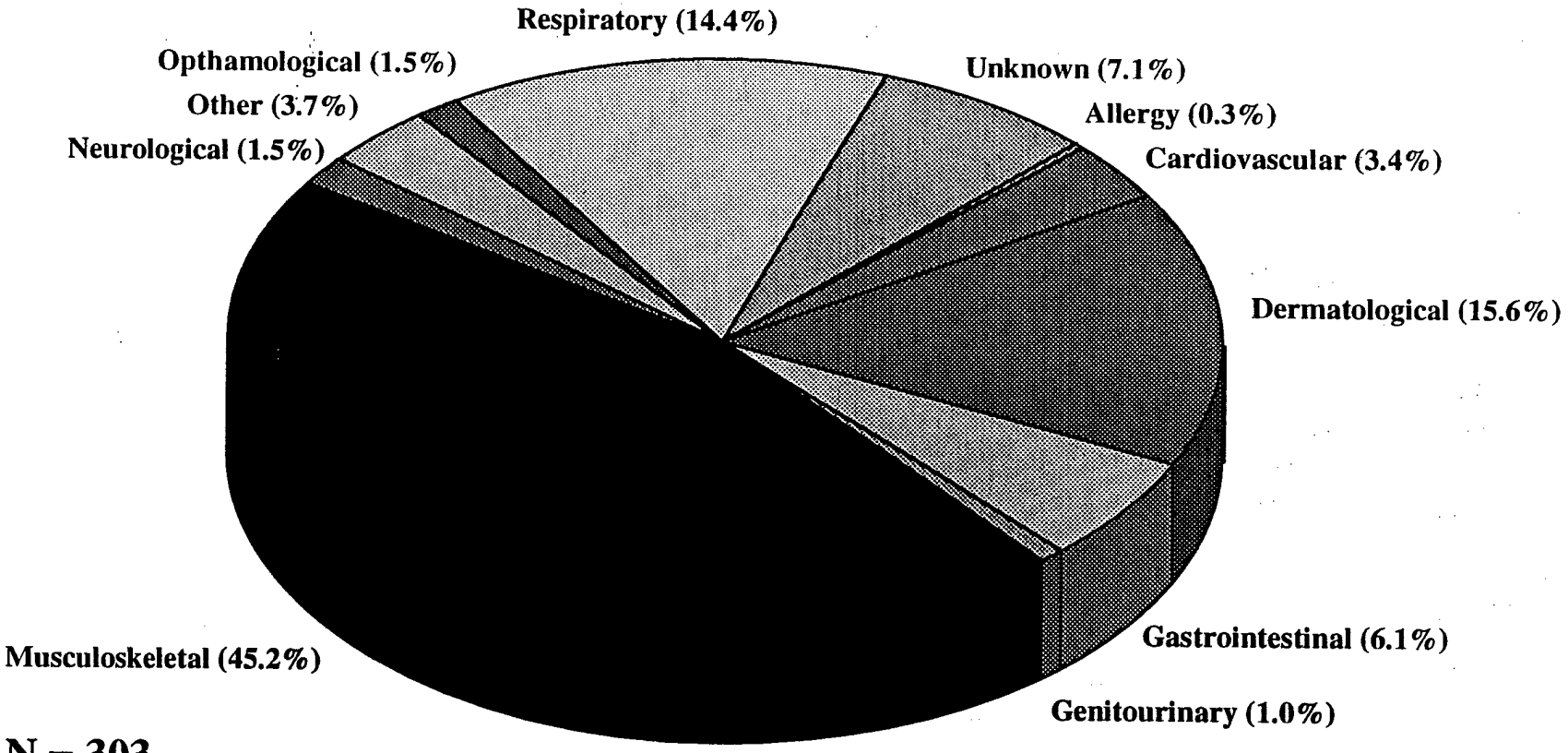
N = 8,865

Figure 2
Distribution of Morbidity Among
MCRD, Parris Island, Female Recruits (4,508 New Encounters)
1 APR 95 - 30 JUN 96



N = 2,766

Fig. 3
Distribution of morbidity among
OCS, Quantico, female candidates (589 new encounters)
1 JUN 95-30 SEP 96



N = 303

List of all personnel receiving pay from the contract support

Sally Donnell

Lonna Gellis

Stanley I. Ito, MPH

Anh T. Le, MS

Karen Maxwell-Williams, MS

Nancy McGinnis

Patti Tracy

Steve Tschinkel